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THE RELATIONSHIP BETWEEN BODY-MASS INDEX AND ACADEMIC ACHIEVEMENT IN THIRD-GRADE WHITE FEMALES

by

Laura Steiniger

A Thesis Submitted to the Faculty of the

DEPARTMENT OF NUTRITIONAL SCIENCES

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE
WITH A MAJOR IN DIETETICS

In the Graduate College

THE UNIVERSITY OF ARIZONA

1997

STATEMENT BY AUTHOR

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ACKNOWLEDGMENTS

I would like to express my sincerest gratitude to Dr. Wanda Howell for her guidance, encouragement, and assistance over the years. Having Dr. Howell as a professor, mentor, and role-model during my undergraduate and graduate program at the University of Arizona has been a priviledge. I thank her for her encouragement to remain dedicated to achieving this academic goal.

A special thank you to Dr. Douglas Taren for providing me with information about the OMNIBUS project and helping me to develop the subject of this thesis. His encouragement, professional expertise and enthusiasm for this study guided me throughout the entire research process. Thank you for helping to keep me focused and goal-directed.

Also, thank you to Anibel I. Hill for her assistance with the statistical analysis of my data, and to Mary Marikos for her assistance with research. I truly appreciate all you have done to assist me.

Finally, it is with sincere appreciation that I acknowledge George D. Comerci, M.D. for his infuence on my career as a dietitian. It was through his teaching, his professionalism and his friendship that my interest in child and adolescent nutrition flourished. By example, he taught me not only the science, but the art of caring for children.

DEDICATION

To my husband, Fred, whose love, constant encouragement, and belief in me allowed me to realize this goal. Also, to my children, Benjamin, Jessica and Joelle, whose patience and understanding allowed me to pursue my academic dreams. I am grateful to all of you.

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ABSTRACT

This study examined the relationship between BMI and academic achievement in third-grade white females. Academic achievement was determined by classroom grades and standardized achievement test scores (e.g. CTBS). Also assessed were teachers' predictions for school success and teachers' perception of student behavior.

The results of the investigation indicated no statistically significant differences in classroom grades between groups of "normal-weight" students and a group of obese students. However, teachers predicted less school success for obese girls and the highest degree of school success for the thinnest girls, and ANCOVA revealed statistically significant lower CTBS scores for obese girls. While MANCOVA of BMI and other confounding factors on CTBS scores showed BMI was not statistically significant, a relationship does exist. A model is proposed linking BMI and academic achievement through the mediating factors of teachers' predictions for success (teacher expectancies) and parents' level of education.

CHAPTER 1. INTRODUCTION

Statement of the Problem

Over the past 25 years our population has become increasingly obese. In particular, the prevalence of obesity in school-aged children has climbed dramatically in the past decade. The National Health and Nutrition Examination Surveys (NHANES), conducted by the National Center for Health Statistics, Centers for Disease Control and Prevention, collected data on between 3,000 and 14,000 children aged 6 through 17, in each of six separate surveys, during the years 1963 to 1994. NHANES II, conducted between 1976 - 1980, showed the prevalence of overweight males (95th percentile BMI), all races, between the ages 6 - 11-years-old was 7.9%, and in 12 - 17-year-old males the prevalence was 5.4%. In 6 - 11-year-old females, all races, the prevalence of overweight was 7%, and in 12 - 17-year-old females the prevalence was 6% (Troiano, Flegal, et. al, 1995). NHANES III, conducted in two phases between 1988 - 1994, approximately a decade after NHANES II, showed the prevalence of obesity in 6 - 11-year-old males almost doubled, increasing to 14.7%. The prevalence of obesity in 12 - 17-

year-old males more than doubled, increasing to 12.3%. NHANES III showed the prevalence of obesity in 6 - 11-year-old females almost doubled, increasing to 12.5%, while the prevalence of obesity in 12 - 17-year-old females increased to 10.7% (Anonymous, MMWR, 1997). At the end of phase I of NHANES III, in 1991, it was estimated there were approximately 4.7 million overweight youngsters (≥95th percentile BMI) aged six - seventeen in the United States (Troiano, Flegal, et. al., 1995).

Obesity is the most common form of malnutrition and a significant cause of serious health problems in the U.S. (Tershakovec, Weller, and Gallagher, 1994). Obesity is commonly associated with increased risk of cancer, cardiovascular disease, hypertension, gallbladder problems, and diabetes, and has become a major public health concern.

The medical complications of childhood obesity are well documented in the Bogalusa Heart Study (Aristimuno, et al, 1984). Obese children are at increased risk of developing respiratory disease, orthopedic problems, especially in their legs (Williams, Bollella, and Carter, 1993), left ventricular hypertrophy, (Gutin and Manos, 1993), and skin problems, including intertrigo, rashes, and striae (Williams, et al, 1993). During childhood there is an association between obesity and high blood pressure levels, high levels

of very low density lipoprotein cholesterol (VLDL cholesterol), lower levels of high-density lipoprotein cholesterol (HDL cholesterol), higher insulin levels, increased heart rate, and increased cardiac output (Berenson, Spinivasan, Wattingney, and Harsha, 1993).

Along with the physical morbidities associated with obesity, according to Must of Tufts University School of Medicine, "social isolation and peer problems are the most prevalent and immediate consequences of overweight in the young."(Must, 1996). Morbidly obese children and adolescents have been observed to have lower self-esteem, depression, anger and hostility, extreme passivity, inadequate socialization skills, enuresis, and school phobia (Boeck, Lubin, Loy, et al, 1993).

In addition, while the medical and the psychosocial problems associated with childhood obesity are well-documented public health problems, pediatric obesity may also lead to educational problems. It is possible that obese youngsters are viewed less favorably by their teachers. A child's poor self-esteem, along with lower teacher expectations, may mean that childhood obesity is an educational handicap. The purpose of this thesis was to examine evidence from the OMNIBUS project, a longitudinal study conducted by the Pinellas County School District of Florida, for considering

childhood obesity as an educational handicap. In particular, this thesis examined the association between students' obesity on academic achievement and teachers' predicted school success.

Definition of Key Terms

Obesity

The term "obesity" appears throughout this thesis. While there is no universally accepted definition of obesity, one definition is, "a maladaptive increase in the amount of energy stored as fat" (Boeck, Chen, and Cunningham-Rundles, 1993). More specifically, childhood obesity is characterized by excess fat mass resulting from energy intake exceeding energy expenditure plus the energy required for normal growth and development, over an extended period of time (Roberts, 1993). A definition of relative obesity is a level of weight in excess of a standard for a given height in the individual's age and sex group, the standard having been derived from a reference distribution for the population. While the exact criteria for defining obesity may differ among investigators, most would agree that the

term obesity implies morbidity associated with excess fat deposition. For purposes of this study, the term obesity refers to those students who are at or above the 95th percentile for body-mass index (BMI) for their age and sex, according to NHANES I Standardized Percentile Curves (non-institutionalized civilian population from the continental United States).

BMI

The term "BMI" refers to body-mass index, a measure of weight relative to stature that is computed using the equation W/H^2, where H = height in meters and W = total body weight in kilograms. BMI, also known as Quetelet Index, is often used as an index of overweight in children (Rolland-Cachera, Sempe, Guilloud-Bataille, et al (1982).

Academic Achievement

Another term that appears throughout this thesis is "academic achievement". For purposes of this study, academic achievement will refer to two measures. The first measure is students' end of school-year classroom

grades in math, science and reading. The second measure is student performance on a national standardized achievement test, namely the Comprehensive Test of Basic Skills (CTBS), in the areas of math, reading and total battery.

Teachers' Predicted School Success

Finally, another term or phrase that appears throughout this investigation is "teacher predicted school success." This phrase is from a question that appeared in the Teacher's Survey (See Appendix A), a questionnaire that was completed by classroom teachers as part of the OMNIBUS study (OMNIBUS study is detailed in the Methods section of this thesis). In this question, teachers were asked to predict whether a student will have an overall successful school experience. It, therefore, is an indication of teachers' expectations regarding students' future academic achievement.

Purpose of the Study

The central purpose of this investigation is to examine whether there is evidence to support the notion that obesity in schoolchildren negatively impacts academic achievement, and is an educational handicap. This cross-sectional study was undertaken to provide empirical support for the hypothesis that there is a relationship between BMI in third-grade white females and academic achievement. In addition, two secondary issues were explored. First, a longitudinal comparison of teachers' predicted school success and academic achievement was conducted in order to investivate whether obese students were predicted to be less successful than their thinner counterparts. This is accomplished by comparing second-grade teachers' predictions for school success and third-grade classroom grades and CTBS percentile scores in children in various BMI groups. Second, an examination of teachers' perception of student behavior in second-grade was conducted to examine whether obese youngsters were perceived to have worse behavior than their thinner counterparts. These comparisons were made while controlling for various factors believed to have a confounding influence on academic achievement.

Hypotheses

The primary question of interest in this investigation was: "What is the relationship between BMI and academic achievement?" This question was answered by testing the following hypotheses:

1) There are no differences in classroom grades between groups of "normal-weight" third-grade white females and a group of obese third-grade white females (BMI of 95th percentile or greater) participating in the OMNIBUS project (Hypothesis 1).
2) There are no differences in scores on a national standardized achievement test between groups of "normal-weight" third-grade white female students and a group of obese third-grade white female students (BMI of 95th percentile or greater), participating in the OMNIBUS project (Hypothesis 2).

Secondary questions that were investigated were: "What is the relationship between teachers' predicted school success and BMI, and teachers' predicted school success and academic achievement?" These secondary questions were answered by testing the following hypotheses:

1) There are no differences in teachers' predicted school success

according to the level of BMI of third-grade white females participating in the OMNIBUS project (Hypothesis 3).

2) Teachers' predictions for school success during second-grade are not related to actual third-grade performance (Hypothesis 4).

As a separate issue, but related to a student's overall performance in school, is the question of behavior. To investigate differences in behavior by BMI group, the following hypothesis was tested:

1) There are no differences in teachers' perception of student behavior between groups of "normal-weight" third-grade white female students and a group of obese third-grade white female students participating in the OMNIBUS project (Hypothesis 5).

CHAPTER 2. REVIEW OF LITERATURE

This chapter reviews the literature that relates childhood obesity to academic achievement, and to teacher expectations. The argument advanced in this chapter is that obesity negatively impacts academic achievement. Also, teachers' expectations regarding school success for their students may be negatively influenced by a student's physical appearance. While there are numerous studies of obesity in children related to psychological effects, etiology, development and state of health, there is a paucity of research related to the subject of obesity and academic achievement. The literature was searched using the Medline, Psych Information, and ERIC databases, as well as other sources of information. Additionally, while acknowledging that race and nationality may have a confounding influence on the psychological effects of obesity, as well as societal acceptance of obesity, given the small body of research on the subject of this thesis two studies from foreign countries were included in this literature review.

Terschakovec, Weller, and Gallagher attempted to look at obesity and school performance by examining 104 inner-city, black, third- and fourth-

grade students from a low socio-economic status, who attended a public elementary school in Philadelphia. Subjects were determined to be obese if they had a triceps skinfold (TSF) greater than the 85th percentile using race-, gender-and age-specific standards (e.g., US Dept. Of Health and Human resources 1981: *National Health Survey)*. Thirty-five percent of the study sample (39% of the boys and 32% of the girls) were determined to be obese by TSF greater than 85th percentile. The investigators conducted a 30-45 minute telephone interview with the primary care taker of each participating student. The interview included responses to the Child Behavior Checklists (CBCL), a subscale of the Conners' Parent's Questionnaire. Information about school absences and placement in remedial classes was obtained from school records. After controlling for birth weight, age, sex, family income and school absences, the obese students were found to have significantly more behavior problems and were more often placed in a special education or remedial class setting. While the average behavior scores for the obese students were within the normal range, these children showed significantly higher scores on behavior tests, suggesting they might have more behavior problems. Additionally, the obese girls had significantly higher scores on the 'sex problems' CBCL subscale. The investigators stated that behavior

differences of obese children may cause school problems and lead to a higher percentage of these students being placed into special classroom settings, as compared to their normal-weight counterparts (Tershakovec, et al., 1994). Additionally, Strauss, Smith, Frame, and Forehand (1985), in their study of second- through fifth-grade students found that obese children, compared to non-obese children, were rated as having more conduct problems (teacher ratings), nominated as least liked and chosen as least preferred playmates by peers.

Karen Volz Bachofer (1993) in her doctoral dissertation entitled, *Hidden Messages: Student Perceptions of Teacher Expectation Communication* reports that studies in recent years confirm that teachers' expectations do effect both teacher-student relationships and student performance. Teachers transmit a variety of expectation messages to their students, both directly and indirectly and consciously and unconsciously. Perhaps the most powerful teacher expectation is that of self-fulfilling prophecy. The self-fulfilling prophecy effect leads to significant changes in student behavior (Good and Brophy, 1986). Additionally, since students are motivated to perform or not to perform according to their perceptions of teacher expectations, differential treatment of students might strongly and

negatively affect their academic achievement.

An investigation by Villimez, Eisenberg, and Carroll (1986) illustrates how the physical stature of a student may influence both teacher expectations and student academic achievement. This study is important in two respects. First, it indicates that both teacher expectancies and student performance might be affected by the weight and stature of students. Second, it illustrates that these influences may be differentiated by sex. The study population consisted of 388 students from kindergarten through fourth grade. The teachers were asked to rate their students both in September and January on four areas: academic aptitude, athletic ability, social competence, and independence. These ratings were adjusted by the researchers on the basis of class and grade.

The four independent variables in their study were labeled and defined as follows: size, defined as height while controlling for age; height, defined as height while controlling for both age and weight; bulk, defined as weight while controlling for age; weight, defined as weight while controlling for both age and height. The data for males and females was analyzed separately. For males, there was a positive significant relation between teacher ratings in all four areas (described above), with size and height in September, and in all

areas except academic aptitude in January. Males' bulk had a positive, significant correlation with teacher ratings of independence and academic aptitude in September but only with independence in January. At no time were the teachers' ratings significantly related with boys' weight. For females, height and size were not related significantly to teachers' ratings of competence while both bulk and weight had significant negative correlations with teachers' ratings.

Villimez, et al. also used the four independent variables as predictors of standardized achievement scores and report card grades. For the girls, their height and weight were not significant predictors of either criterion while size and bulk were both significant predictors of report card grades in the negative direction. For the male students, bulk, weight, and size showed a positive significant correlation with both grades and achievement. Height was not significantly related to either.

John G. Freeman (1990), conducted a study entitled, The relationship between obesity and academic achievement in grades four to six. He examined the relationship between obesity in 214 Canadian children, grades 4 - 6, as measured by ponderal index (the cube root of weight divided by height) and a self-report subjective obesity scale, and academic achievement,

assessed by using the results of the Gates-MacGinite Reading Test, Level D. He also examined the effects of two confounding factors: 1) teachers' expectancies, measured by teacher predictions of student academic success, 2) students' self-esteem, rated using Mendelson and White's body-esteem scale, and Dimensions of Self-Concept (DOSC),

Level E.

Freeman found no significant relationship between objectively measured obesity, ponderal index, and academic achievement on a standardized test. Further, he found that only for fourth-grade students, ponderal index (objectively measured obesity) and teacher expectancies had a correlation coefficient of -0.20. In other words, fourth-grade teachers may have let a student's obesity negatively affect perceptions of the student's academic achievement potential. Further, the relationship between self-concept/body

esteem (subjectively measured obesity) and academic achievement was highly significant for girls in all grades ($p \leq 0.01$). Sixth-grade girls in particular, who thought of themselves as obese were rated lower by their teachers for academic achievement potential. Freeman also found teacher expectancy was a highly significant predictor of student academic

achievement in all sub-groups ($p \leq 0.01$). This result was largely unaffected when controlling for grade or sex. Freeman believes that it is through biasing of instruction, based on teacher expectancy, and through the communication of negative attitudes to students, that teacher beliefs exert an effect on student performance.

Finally, X Li (1995) observed a higher percentage of obese children in remedial classes in primary school in Nanjing, PRC. In 1995 he conducted a study to investigate differences in measures of intelligence and personality between obese and normal-weight children. What Li found was that severely obese children (those found to be > 50% overweight as determined by the formula: actual weight - standard weight for height x 100 / standard weight for height) had significantly lower performance IQ's than controls, and scored significantly higher on the psychoticism portion of the Eysenck Personality Questionnaire. Differences were not observed in youngsters with milder degrees of obesity.

For his study, Li selected 102 pairs of children, ages 6-13 years (mean age 9.8 years). The case-control children were chosen from the same class as the obese children and matched for sex, height and age. There were 65 pairs of boys and 37 pairs of girls. Assessments of intelligence were made using

the Wechsler Intelligence Scale for Children, in a form revised by the East China Normal University, producing three overall scores: a verbal IQ, a performance IQ and a total IQ score. Personality was assessed by using the Eysenck Personality Questionnaire (Junior), in a form revised by the Hunan Medical University. This instrument yielded scores on extroversion, neuroticism and psychoticism scales. Li points out that other investigators have shown that within the same age group, early-maturing children have higher intelligence scores than late-maturing children. Li deduced that since obese children, in general, mature earlier than their normal-weight counterparts, their intelligence should have been higher than for age-matched controls, but the study's results were contrary to that notion.

Our nation's schools remain unsuccessful in their attempts to educate large segments of our population, especially those students living in poverty, students of racially and ethnically diverse backgrounds, and those students with educational/emotional handicaps. The literature seems to indicate that childhood obesity may indeed be an educational handicap. With the numbers of ethnically diverse students growing, the unresolved problems of poverty, and the increase in childhood obesity, our schools may be turning out young people who are ill-prepared to face the challenges of the 21st century. Our

nation may be at greater risk now than when the Commission on Excellence in Education issued *A Nation at Risk* in 1983.

From the research previously cited, relatively few studies directly examine the relationship between obesity and academic achievement in children. Though student behavior and teachers' perceptions are often examined, one rarely sees academic achievement, as it relates to BMI, as an outcome variable measured in these studies.

Since there is a paucity of information in this particular area, the present investigation will contribute to the scientific and educational literature by examining the relationship between BMI and academic achievement.

CHAPTER 3. METHODS

Study Design

This investigation utilized a longitudinal design to determine the relationship between BMI and academic achievement in third-grade white females from Pinellas County, Florida. The study was longitudinal in that the dependent variables used for academic achievement in third grade were measured after collecting data on teachers' predicted school success and teachers' evaluation of student behavior in second-grade. The effect of the interaction between teachers' predicted success and BMI (collected in third-grade) was also examined. Additionally, a crossectional design was used to examine the relationship between BMI and academic achievement, in third-grade.

The Omnibus Study

The present study used data from the OMNIBUS project, a 13-year

longitudinal study conducted by the Pinellas County School Board, of the graduating class of 2002. The OMNIBUS project began in the 1989-1990 school year, when all 8,268 students who registered for kindergarten were designated as OMNIBUS students. This cohort of students is being followed in order to collect trend data as they pass through their 13 years of education in the Pinellas County school system. The OMNIBUS data has been used for a variety of purposes, including, but not limited to the following:

- Early intervention of students who are at risk of failing kindergarten.
- ALPHA program: tracks the progress of high risk students receiving special treatment.
- Early identification of students at risk.
- Nutrition, school performance, and child health: looks at the relationships between nutrient intake, meal patterns, consumption of various food groups related to academic achievement and obesity in children.
- Math achievement: looks at family and personal variables to explain math achievement of third grade students.

The data collected for the OMNIBUS project were derived primarily from two sources: 1) the Pinellas County Student Information System (SIS),

and 2) annual surveys. SIS is comprised of a comprehensive set of data for each student that includes such information as demographics (e.g., gender, race, age), student performance (e.g., class grades, scores on standardized tests, attendance, disciplinary actions), and other classification data (e.g., eligibility for participation in federal lunch program). The surveys were administered annually to OMNIBUS students, their parents, and their teachers. These surveys presented questions that would help provide a more complete description of each individual student. For example, the student survey included questions regarding self-esteem, friendships, and attitudes (e.g., feelings about appearance, ability to make friends, and whether they have lied or taken things that were not theirs). The parents were surveyed on numerous areas (e.g., number of parents in home, critical family events, child's behavior and attitude toward school, parent's school participation, conflict or problems in family life, educational level of parents, etc.). The teachers assessed each of their students in five areas (e.g., difficulty paying attention, meetings with child's parents, services child has received from instructional volunteers, attitude toward, and behavior in school, and predicted school success).

The nutritional component of the OMNIBUS project was conducteded by Dairy Management, Inc.(formerly the National Dairy Council) Research Project of the University of South Florida (USF). Food frequency questionnaire's (FFQs) were used to gather information about dietary intake. Anthromometric data were also collected for each student and included weight, height, waist and hip circumference measurements.

Population and Sampling

The sample population for the present investigation included 1,667 white, female, third-grade elementary school children from Pinellas County, Florida who were enrolled in the 13-year OMNIBUS project of the graduating class of the year 2002. There were 8,268 school children enrolled in the OMNIBUS project upon entering kindergarten in 1989.

Due to the longitudinal design of this investigation, we chose only those third grade students who had participated in the OMNIBUS project since kindergarten. The sample population of third-graders was therefore reduced to 4,974 students. Since we further limited our study to white females, 2,538 students were eliminated from the sample because of male

sex. Additionally, 568 students were deleted from the data set due to a different racial category. Finally, 201 students were removed from the sample population because of missing data (e.g., grades and anthropometric measurements).

Informed Consent

A letter notifying parents that the USF research team would be collecting anthropometric measurements on students involved in the OMNIBUS project was sent home with each third-grade student. See Appendix A). At that time, parents were given the opportunity to refuse these measurements and they had to indicate their desires in writing. In addition, at any time during the actual collection of the anthropometric data, any student had the right to verbally refuse to participate in this study (Brown, 1993).

Confidentiality

During this study, the confidentiality of all students with respect to anthropometric data, student surveys, parent surveys, and teacher surveys was maintained. To ensure confidentiality, each student was identified by her student identification number, and these identification numbers were used for data entry. Therefore, student names were not used or recorded during the data analysis.

Data Collection

Student Demographics and Survey Information

Student demographic information was obtained for the present investigation from the SIS portion of the OMNIBUS project. This included student ID number, race, gender, age, student performance (grades), attendance, disciplinary actions, and classification data (e.g., eligibility and participation in federal school lunch program). The survey information, previously described, was obtained annually via parent, teacher or student surveys. All of the survey responses were made on computer-scannable forms, allowing for quick and accurate recording of survey information into

the student's record. Parents returned their questionnaires directly to the schools or directly to the school district office in a pre-addressed enveloped.

In an effort to secure commitment from the participants in the OMNIBUS project, the Superintendent of Schools for Pinellas County enlisted the support of school principals, parents and teachers. Over the subsequent years of the project, school principals were informed of the upcoming surveys at the Superintendent's meeting. Parents were made aware of upcoming surveys via school newsletters. Also, during some years, the students were given small incentives such as bookmarks or magnets for returning parent surveys.

All returned surveys were first visually inspected for stray marks to ensure identifying information was properly indicated on the response sheet. The response sheets were then scanned and output to disk. Then, the output data files were examined for miscoded responses and duplicate student IDs. If a student appeared more than once, his/her original response sheets were re-examined and the erroneous case was deleted from the data file. Miscoded responses were recorded so they could be distinguished from missing data.

Standard Anthropometric Data

The anthropometric data was collected as part of the Dairy Management, Inc. Project of the USF. The UNICEF protocol for collection of anthropometric data in children was used for this project (How To Weigh and Measure Children, UNICEF, 1993). In order to standardize measurement techniques and control for intra- and inter-individual errors among research staff members, a 3-day training session was conducted. On Day 1, the research staff members learned: 1) to calibrate the equipment, 2) proper "rounding off" techniques for recording anthropometric measurements, and 3) random selection to determine reliability. The staff members also received instruction on completion of anthropometric forms and standard measurement procedures for collection of data on height, weight, waist, and hip circumferences (see Appendix B. for anthropometric form).

On the second day of the training session, staff members were divided into three groups and practiced measurement techniques by obtaining the selected measurements on each other. Each team consisted of four individuals, each assigned to perform a specific task. Each team had one person assigned to measure height, a second person to measure weight, a

third member for measuring both waist and hip circumferences, and a fourth member to provide "gatekeeping" duties and to record the measurements obtained by the waist/hip measurer. Each group gained experience by obtaining measurements on individuals from the other teams. The results of these measurements were used to evaluate intra- and inter-individual variation.

The third training session involved a pilot test . The three teams visited a preschool setting and each team was given the opportunity to obtain anthropometric data, according to their pre-determined assignments.

Following completion of the training sessions, the three teams were assigned to the various Pinnelas County elementary schools. Smaller schools were assigned one team to obtain the anthropometric measurements; larger schools were assigned two or three teams to complete the measurements.

Each team used a digital scale (which measured weight to the nearest 0.1 pound); this scale was calibrated daily using standardized weights. Standing height was measured with a flat headboard and a vertical wall which was equipped with a metal measuring tape. The height instrument was also calibrated daily by using a designated team member as the standard height measurement. All measurements performed on the schoolchildren were

recorded to the nearest 0.1 pound and 1/8 inch, respectively. All measurements were obtained twice so as to obtain a mean value. Children were instructed to wear light clothing to school on the day of the measurements, and heights and weights were obtained without shoes.

Standardized waist and hip circumference measurements were taken over the top of the children's clothing, due to liability issues. The measurements were made twice using cloth measuring tapes, and similar to the height and weight procedures, the mean measurement was used for both waist and hip readings. All measurements were recorded to the nearest 1/8th inch.

If there was a discrepancy between the first and second readings of greater than 0.2 pounds for a student's weight, or greater than 1/4 inch for height, waist, or hip circumference, then a third measurement was required in order to resolve the difference between the first two readings.

Additionally, excluded from the final anthropometric data sample were any students who had leg or arm casts, extremely heavy or bulky clothing, large hair adornments, or any other condition which produced measurement errors.

Finally, a random 10% sample of students were re-measured each day

to examine intra-observer measurement error. Random numbers were computer-generated and compared to student identification numbers for selection. This procedure provided an estimate of the degree of reliability obtained with these measurements. The results of this procedure revealed an acceptable level of reliability. The reliability results were as follows:

Weight	0.9989
Height	0.9768
Waist Circumference	0.9777
Hip Circumference	0.8646

The somewhat lower reliability for the hip circumference is likely a result of two factors, namely, differences in tension applied to the measuring tape upon repeat measurements and loose or "baggy" clothing.

OMNIBUS Data

The OMNIBUS study's data set contains six major categories of information which include: achievement, affect information, family characteristics, physical health, school experiences, and student identification. Sex and race information were obtained from the student identification category of the OMNIBUS study data set. The present investigation included

only white females, in order to control for differences in BMI based upon these variables, and to control for any bias that these variables might produce in the classroom. The OMNIBUS Advisory Committee and the Pinellas County School District approved the use of the data for analysis.

Study Variables

Measurements of Body Size

BMI was used as the measure of obesity in the present study. There are numerous methods of measuring and/or calculating adiposity, all with their own limitations and advantages. Specifically, these methods include underwater weighing, bioelectrical impedance, dual energy X-ray absorptiometry (DXA), and anthropometry, such as tricep skinfold (TSF) thickness measurement, waist-to-hip ratios, or weight-height indices.

Underwater weighing presents a host of problems when working with a large population including: subjects' fear and refusal of being submerged underwater, lack of portability of measuring device, time-consuming measurement, and expense of measurement. While DXA may be an

accurate, though expensive and time consuming measurement of adiposity, a recent study by Goulding, et al (1996) found that DXA-derived fat mass correlates well with BMI throughout the "normal" range of BMI (5-95th centiles), and supports the use of BMI as a simple measure of fatness in girls. They recommend that children with BMI values outside the normal range may benefit from a more exact body composition measurement such as DXA. Additionally, Lazaruus, et. al., 1996, confirmed good correlations between BMI and DXA-derived measurements of fat mass in Australian children.

For these reasons, anthropometric measurements remain the most commonly used field measures of adiposity in clinical and epidemiologic studies. Studies involving both children and adults demonstrate strong correlations between TSF and BMI (Hammer, LD, et. al., 1991; Rolland-Cachera, MF, et. al., 1982; Rolland-Cachera, MF, et. al., 1984; Straw and Rodgers, 1985). Traditional weight-for-height indices, or body mass indices, include weight/height, weight/height^2 (Quetelet's Index), weight/height^3 (Rohrer's Index), and weight/height^p (Benn's Index). The ideal body mass index should correlate most accurately with weight and adiposity and be minimally biased by height. Lazarus, Baur, Webb and Blyth (1996), in their study comparing Benn's index to skinfold thickness measurements in

8,492 Australian schoolchildren aged 7 to 15, found that Benn's assumption of low correlation between height and adiposity was not satisfied in children. Further, they concluded that of the various indices of weight/height examined, weight/height^2 was most closely associated with adiposity in children.

Similarly, Rolland-Cachera, et al (1982) conducted a study to compare the validity of three body mass indices in children: weight/height, weight/height^2 (Quetelet's Index), and weight/height^3 (Rohrer's Index). Quetelet's Index correlated more favorably than the two other indices with the conditions of low correlation with height and high correlation with weight and skinfolds. These correlations were higher in children less than 1 year and more than 6 years and lower in children aged 1 to 6 years. Apparently two phenomena, occurring simultaneously, accounted for this discrepancy: 1) the different stages of development in children at a given age; and 2) accretion or depletion of fat stores at different periods of growth. Despite these issues, Rolland-Cachera, et al. concluded that the Quetelet's Index was suitable for application to children. Therefore, Quetelet's Index for calculating BMI was utilized in the present study.

In the present study, students' heights and weights were used to calculate BMI. BMI was calculated using Quetelet's Index of weight/height^2.

Those students determined to have a BMI at or above the 95th percentile for age were classified as obese. This is considered to be a conservative cutoff point for defining obesity in children (Hammer, et. al.,1991). The percentile values of BMI were obtained from the Percentile Values of Body-Mass Index, NHANES I tables (National Health and Nutrition Examination Survey, 1971-1974). This reference data provided race, sex, and age-specific percentiles for BMI (weight/height^2) for people aged 6-74 years. The following illustrates the smoothed percentiles of BMI from NHANES I, for 8 and 9-year-old white females:

Age	Percentile						
	5	10	25	50	75	90	95
8	13.6	14.2	15.0	16.0	17.2	19.4	21.0
9	14.0	14.5	15.5	16.6	18.0	20.8	22.7

Since some of the subjects were 8-years-old and some were 9-years-old, they were first sorted by age, according to birthdate. Secondly, they were assigned a BMI percentile based upon their age and their BMI. Finally, the subjects were placed into one of five BMI groups as follows:

Group 1. < 25th percentile
Group 2. 25-49th percentile
Group 3. 50-74th percentile
Group 4. 75-94th percentile
Group 5. >95th percentile (Designated obese group)

Academic Achievement

Academic achievement was measured by two methods. First, end of school-year third-grade classroom grades in math, reading and science were obtained for each student. The letter grades for these subjects were assigned numeric values as follows: A=5 B=4 C= D=2 F=1. The students' numeric grades for these three subjects were recorded.

Second, academic achievement was also measured by obtaining the student's scores on the math and reading sections, as well as the total battery score of the Comprehensive Test of Basic Skills (CTBS). The CTBS is a national standardized test administered to the students attending Pinnelas County elementary schools sometime during the third grade. The CTBS are achievement tests that may be used to assess the basic skills attained by students in kindergarten through the twelfth grade. This battery provides norm-referenced and criterion-referenced interpretations of the scores. The norm-referenced interpretations include percentile ranks, grade-equivalent scores, stanines, and normal curve equivalents (standard scores with a mean of 50 and a standard deviation of 21). For the present investigation, the students' percentile ranks were recorded for each of the three measured areas.

Teacher's Predicted School Success

The teachers' predicted school success for their students was measured by their response to a question from the Teachers Survey (See Appendix C), completed by the students' second-grade teachers:

> "To what extent do you agree with the statement, 'This student will have a successful overall school experience'?"
> 1 Strongly Agree
> 2 Agree
> 3 Undecided
> 4 Disagree
> 5 Strongly Disagree

The teachers' responses to this question were recorded for each subject. It should be noted that Teacher Surveys were missing for 137 students in our sample population. A distribution of missing surveys was constructed and it was determined that the missing Teacher Surveys were evenly distributed across BMI groups. Therefore, we did not eliminate those students with missing Teacher Surveys from our investigation. Instead, when analyzing teachers predicted success, analysis was performed on this sub-population consisting of 1530 students, for which we had completed Teacher Surveys.

Teacher Perception of Behavior

Though not a main focus of this investigation, as noted in the Review of Literature section, studies have observed obese students to have more behavior problems in school. This investigator was interested in examining whether a similar observation would hold true for this student sample. Therefore, teacher responses were recorded to the following question from the second-grade Teacher Survey (See Appendix C):

> "Choose the answer that best describes this student's behavior in the school."
>
> 1 Excellent
> 2 Satisfactory
> 3 Needs Improvement
> 4 Unsatisfactory

Socioeconomic Level

Socioeconomic level (SEL) is one of the factors thought to have a confounding influence on academic achievement. In order to control for SEL in the present investigation, eligibility for the federally funded school lunch program was used as a measure of SEL of the students. The students

qualified either for free, reduced-price, or full-pay school lunches based upon their family's level of income. Those students qualifying for free lunch lived in families with an annual income of no more than $18,135 for a family of four (<100% of the poverty level). Those students qualifying for a reduced-price lunch lived in families with an annual income of no more than $25,808 for a family of four (<185% of poverty level). Those students who paid full price for lunch lived in families whose annual income exceeded $25,808 for a family of four (USDA Child Nutrition Program Income Guidelines, July 1, 1992 - June 30, 1993).

Data Analysis

The anthropometric forms were prepared for analysis by USF graduate students. The prepared forms were scanned at the Pinellas County Department of Education Accountability using the software program Scan Tools and the National Computer Services Optical Scanner.

Descriptive statistics were used to characterize the study sample. Demographic variables, such as race and sex were determined by percentages, and absences were determined by means. Calculations were

performed to determine the percentage of children who met obesity criteria (95th percentile from reference data), and to develop specific BMI groups. Other descriptive statistics included mean and standard error of the mean for grades and CTBS percentile scores. Pearsons correlation coefficient is used to determine linear relationships between variables.

Throughout the data analysis, grades are divided into the categories of: math, reading and science. CTBS percentile scores are divided into the categories: total battery, math, and reading. For Hypotheses 1 and 2, one-way analysis of variance (ANOVA) was used for comparison of means, to determine whether any differences existed in classroom grades between the five BMI groups. Likewise, ANOVA was used to test for any differences in mean CTBS percentile scores between the five BMI groups. If ANOVA revealed a statistically significant difference, then a set of orthogonal contrasts were used to compare BMI groups as using a priori comparisons. This set consisted of (1) group 5 vs. 1-4; (2) groups 5 & 4 vs. 1, 2 & 3; (3) groups 5, 4 & 3 vs. 2 & 1, and (4) groups 5, 4, 3, & 2 vs. 1. Control of factors that may contribute to student achievement such as: 1) teachers' prediction for school success, 2) absences, 3) SEL, 4) parents' level of education, and 5) teachers' evaluation of student behavior, was accomplished

using analysis of covariance (ANCOVA).. The contribution of confounding factors along with BMI to achievement scores were assessed using multiple analysis of covariance (MANCOVA). Hypotheses 3 and 4 were also tested with ANOVA in order to determine if any differences existed between teachers' predicted school success, and teachers' perception of behavior between the five BMI groups. A table of teacher's predicted success was constructed for each BMI group so each catagory of prediction could be viewed individually. ANCOVA and MANCOVA were performed to examine the influence of teacher's predicted school success and teachers' evaluation of student behavior with grades and CTBS scores, while controlling for other factors.

CHAPTER 4. RESULTS

The primary purpose of this study was to investigate whether a relationship exists between BMI and academic achievement. Specifically, the analysis sought to examine whether there is evidence to support a hypothesis that childhood obesity is an educational handicap. Additionally, the relationship between BMI and teachers' predicted school success was examined, as well as the relationship between teachers' predicted school success and actual student performance. Finally, BMI and teacher's evaluation of student behavior was examined. The descriptive information regarding the sample population is presented first. The chapter concludes with hypotheses testing using inferential statistics.

Study Sample

Demographic Profile

Table 1 depicts the 4,974 students who participated in the OMNIBUS project from kindergarten through third grade. The study sample was selected from this population.

Table 1. Demographic Distribution of OMNIBUS students (Participated K-3rd Grade)

	Males Frequency	Males Percent	Females Frequency	Females Percent
Asians	27	1.1	52	2.1
Blacks	580	22.9	492	20.2
Hispanics	19	.7	24	1.0
Indians	2	.2	0	0
Whites	1910	75.3	1868[a]	76.7
Total	2538	100.0	2436	100.0

[a]study sample

Since the present investigation was concerned with only third-grade white females, there are 1,868 subjects available. After excluding those students with missing grades, missing CTBS percentile scores, or missing anthropometric data, the sample population was reduced to 1,667 students. This sample population represents 89% of the total number of third-grade white female OMNIBUS students. When investigating the relationship between teachers' predicted school success and academic achievement, a sub-population consisting of 1,530 students was examined. This is due to 137 missing Teacher Surveys, as explained in the Methods chapter of this thesis. This sub-population represents 82% of the total number of white

third-grade female OMNIBUS students.

Anthropometric Measurement Distributions

Height and weight measurements were available for all students in the study sample. Table 2 provides information regarding the ranges, means, and standard error of the means for those measurements. BMI was generated using the formula weight/height^2 (kg/m^2). Each student was assigned a BMI percentile as previously described (see Methods Chapter). Table 3 depicts the BMI percentile groups, and their frequencies, percents, means, and standard error of the means.

Table 2. Anthropometrics of Third-Grade White Females

	Number	Minimum	Maximum	Mean	Std. Error
BMI	1,667	8.30	34.07	17.54	.07
Wt. (Kg.)	1,667	13.73	72.14	30.61	.17
Ht. (M)	1,667	1.02	1.62	1.32	.00
Valid N	1,667				

Table 3. BMI Percentile Groups of Third-Grade White Females

BMI Group	N	Percent	Mean BMI	Std. Error	NHANES I BMI Percentiles
1	358	21.5	14.88	.004	<25th
2	316	19.0	15.68	.002	24-49th
3	301	18.1	16.80	.003	50-74th
4	519	31.1	19.16	.006	75-94th
5	173	10.4	23.91	.163	>95th
Total	1,667	100.0			

Confounding Factors

There are many factors that influence students' academic achievement. The OMNIBUS project provided a variety of information about each student, allowing this investigator to examine and control for some of those factors. Those factors thought to have a confounding influence on academic achievement, for which information was available, included school absences, socioeconomic level, level of parents' education, teacher's predicted school success, and teachers' perception of student behavior.

Absences

In the sample population the fewest number of days missed from school was zero, perfect attendance, and the maximum number of days missed was 56. The mean number of days missed from school by third-grade white females was 7.4±6.8. When absences were examined by BMI groups, there were no significant differences in the mean number of days missed from school, among groups.

Socioeconomic Level

Within the group of 1,667 students, 348 students (21%) received free school lunch, 119 students (7%) received reduced-price lunch, and 1,200 students (72%) paid full price for their lunch. Those students receiving free lunch were from families with incomes $\leq$ 130% of the federally designated poverty line, those receiving reduced-price lunch were from families with incomes $\leq$ 185% of the poverty line, and those students who paid full-price for their lunch were from families with incomes > 185% of the poverty line.

There was no significant difference when a chi square was performed to see if there were differences in the proportion of children in the SEL

groups by BMI groups. Table 4 illustrates the distribution of students in SEL groups (as determined by full pay, free, or reduced lunch), by BMI groups.

Table 4. Distribution of SEL Groups by BMI Groups

Lunch	Group 1	Group 2	Group 3	Group 4	Group 5	Total
Full Pay	260[a]	245	202	372	121	1200
	21.67%[b]	20.42%	16.83%	31.00%	10.08%	100%
	72.63%[c]	77.53%	67.11%	71.68%	69.94%	71.99%
Free Lunch	79	54	71	108	36	348
	22.70%	15.52%	20.40%	31.03%	10.34%	100%
	22.07%	17.09%	23.59%	20.81%	20.81%	20.88%
Reduced	19	17	28	39	16	119
	15.97%	14.29%	23.53%	32.77%	13.45%	100%
	5.31%	5.38%	9.30%	7.51%	9.25%	7.14%
Total	358	316	301	519	173	1667
	21.48%	18.96%	18.06%	31.13%	10.38%	100%
	100%	100%	100%	100%	100%	100%

[a] cell size
[b] row percent
[c] column percent

Parent's Level of Education

When the schoolchildren enrolled in kindergarten in 1989, the parents were asked to complete a Parent's Survey as part of the OMNIBUS project.

From our sample population of 1,667 students, 1,353 of the parents completed that portion of the Parent's Survey pertaining to level of education. The Parent's Surveys were completed by 9% of the fathers, 90% of the mothers, and approximately 1% by guardians, others, or miscoded. The distribution of respondents' (parents' level of education was as follows:

0	Up to grade 7	.6%
1	Grades 8 & 9	2.2%
2	Partial High School	6.9%
3	High School Graduate	36.4%
4	One year College	30.1%
5	College Graduate	17.0%
6	Graduate Degree	6.6%
7	Miscoded	.1%

The levels of education were coded 0 through 7 respectively. The mean level of education for the parents who responded to this question was 3.85 ± 3.83, based on their category classification. In other words, 53.6% of the parents completed at least one year of college. Using the mean category score, ANOVA of the mean level of parents' education by BMI group revealed no significant differences between groups.

Teacher's Predicted School Success

The students' teachers were asked to complete a question predicting students' academic success, as part of the second-grade Teacher's Survey. The teachers were asked to respond to a statement, "This student will have a successful overall school experience?", as follows: 1 = Strongly Agree, 2 = Agree, 3 = Undecided, 4 = Disagree, 5 = Strongly Disagree. The categories Disagree and Strongly Disagree were combined, since there were only 7 responses for the category of Strongly Disagree. Teachers' prediction of school success and mean BMI are presented in Table 5. Based on overall ANOVA, mean BMI by category of teachers' prediction of success was significantly different ($F = 4.17$, $p \leq 0.01$). Teachers' prediction of success was highest for the girls with the lowest mean BMI, ($F = 5.95$, $p \leq 0.01$)

Table 5. Mean BMI for Categories of Teachers Predicted Success

Teachers' Prediction of Success	Mean BMI*	Std. Dev.	Freq.	Percent
Strongly Agree (1)	17.27	2.73	715	46.73
Agree (2)	17.75	3.34	565	36.93
Undecided (3)	17.83	3.29	190	12.42
Disagree (4)	18.14	2.97	60	3.92
Total:	17.55	3.06	1530	100.00

*ANOVA: $F = 4.17$, $p \leq 0.01$
Orthogonal Contrast of Teachers' Category of Predicted Success:
1 vs. 2, 3, & 4: $F = 5.95$, $p \leq 0.01$

Teacher Perception of Behavior

Teachers were asked to complete a question pertaining to student behavior as part of the second-grade Teacher's Survey. The students' behavior was evaluated as: 1 = excellent, 2 = satisfactory, 3 = needs improvement, or 4 = unsatisfactory. There were 1,522 teacher responses to this question. Teachers perceived 58.4% of the students had excellent behavior, 34.11% had satisfactory behavior, 6.43% needed improvement, and .01% had unsatisfactory behavior. ANOVA of mean student behavior revealed no significant differences in student behavior by BMI group. Additionally, summarizing BMI by category of teachers' evaluation of behavior showed no distinct pattern or trend.

Correlations Between Variables

Pearsons correlation coefficient was used to examine the relationship between BMI and all of the continuous variables, e.g., grades, CTBS percentile scores, absences and parent's level of education. Table 6 illustrates these bivariate relationships, showing the correlation and direction

of the relationships, the p-values, and the frequencies. As illustrated, there is a significant negative linear relationship between BMI and math grade, reading grade, CTBS percentile reading score, and CTBS percentile total battery score. There is a weaker correlation between BMI and science grade. Also, BMI was significantly negatively correlated with parents' level of education, that is, as parent's level of education went down, BMI went up. This correlation matrix also indicates that as parent's level of education increased, absences decreased, and grades and CTBS scores increased. Finally, there was a stronger correlation between grades and CTBS scores than between grades and parents' level of education.

Table 6. Correlation Matrix of BMI, Achievement Scores & Parents' Level of Education

	BMI	Abs	Math	Read	Sci	CTBS PctMath	CTBS PctRead	CTBS PctBat
BMI	1.00							
	1667							
Abs	0.04[a]	1.00						
	0.12[b]							
	1667[c]	1667						
Math	-0.05	-0.16	1.00					
	0.05	0.01						
	1667	1667	1667					
Read	-0.06	-0.13	0.65	1.00				
	0.01	0.01	0.01					
	1667	1667	1667	1667				
Sci	-0.04	-0.16	0.71	0.63	1.00			
	0.07	0.01	0.01	0.01				
	1667	1667	1667	1667	1667			
CTBS Math	-0.03	-0.13	0.60	0.55	0.56	1.00		
	0.02	0.01	0.01	0.01	0.01			
	1667	1667	1667	1667	1667	1667		
CTBS Read	-0.07	-0.09	0.57	0.63	0.58	0.66	1.00	
	0.01	0.01	0.01	0.01	0.01	0.01		
	1667	1667	1667	1667	1667	1667	1667	
CTBS Bat.	-0.06	-0.13	0.67	0.67	0.64	0.88	0.89	1.00
	0 .02	0.01	0.01	0.01	0.01	0.01	0.01	
	1667	1667	1667	1667	1667	1667	1667	1667
Parent Level of ED.	-0.07	-0.13	0.29	0.28	0.30	0.28	0.28	0.32
	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	1351	1351	1351	1351	1351	1351	1351	1351

[a] = r value
[b] = p value
[c] = sample size

Hypotheses Testing

Hypothesis 1

There was no difference in classroom grades between groups of "normal-weight" students (BMI of 94th percentile or less) and a group of obese students (BMI of 95th percentile or greater). The null hypothesis was not rejected in this instance because ANOVA comparison between groups revealed no significant difference in mean grades in math, reading and science between BMI groups. Table 7 shows the mean grades and the standard error of the means for math, reading and science, by BMI group.

Table 7. Third-Grade Classroom Grades[a] by BMI Group

BMI GROUP	Math mean	Math standard error	Reading mean	Reading standard error	Science mean	Science standard error
1	4.04	0.05	4.24	0.04	4.21	0.04
2	4.05	0.05	4.13	0.05	4.21	0.05
3	4.04	0.05	4.22	0.05	4.25	0.05
4	4.05	0.04	4.17	0.04	4.20	0.04
5	3.91	0.07	4.06	0.06	4.08	0.07

[a]NOTE: GRADE OF A=5; B=4; C=3; D=2; F=1

Hypothesis 2

There were differences in scores on a national standardized achievement test between groups of "normal-weight" third-grade white female students (BMI of 94th percentile or less) and a group of obese third-grade white female students (BMI of 95th percentile or greater). However, based upon MANCOVA, considering the confounding factors controlled for in this study, the null hypothesis was not rejected. Table 8 shows the mean scores $\pm$ standard errors of the mean, by BMI group, for CTBS math, reading and total battery scores. These data suggest that the obese students had lower percentile scores than the "normal-weight" students. ANOVA of these scores, reveals a statistically significant difference in CTBS math ($p \leq .05$), reading ($p \leq .05$), and total battery ($p \leq .05$) scores by BMI group. Orthogonal contrast of BMI group 5 vs. 1, 2, 3, & 4 confirmed that the obese students received significantly lower scores than the rest of the students, (math $p \leq .03$, reading $p \leq .01$, total battery $p \leq .01$).

Table 8. CTBS Percentiles for Math, Reading, Total Battery by BMI Group

BMI ** GROUP	Math[a] mean	Math std. error	Reading[b] mean	Reading std.error	Total[c] Battery mean	Total Battery std. error
1	67.47	1.47	67.43	1.36	70.14	1.37
2	66.10	1.59	65.52	1.50	68.59	1.54
3	67.52	1.61	64.83	1.53	69.66	1.53
4	69.53	1.20	66.09	1.18	70.24	1.17
5	62.20	2.22	58.99	2.13	62.93	2.12

[a]ANOVA Math: $F = 2.42$, $p \leq 0.05$
[b]ANOVA Reading: $F = 3.12$, $p \leq 0.02$
[c]ANOVA Total Battery: $F = 2.73$, $p \leq 0.03$

Orthogonal Contrast of BMI group 5 vs. 1, 2, 3, & 4
Math: $F = 4.85$, $p \leq 0.03$
Reading: $F = 10.12$, $p \leq 0.01$
Total Battery: $F = 9.11$, $p \leq 0.01$

Factors known to have an influence on student achievement were controlled. Those confounding influences included absences, parents' level of education, socioeconomic level (SEL), teachers' predicted school success, and teachers' perception of student behavior. Covariate ANCOVA of BMI group and each of these factors, for their effect on mean CTBS scores, was performed in order to control for confounding influences. Finally, MANCOVA of BMI, together with all of the confounding influences, was

performed to see whether BMI remained a significant factor affecting student academic achievement.

Table 9 shows the statistics related to CTBS math percentile scores. This includes, by BMI group, the unadjusted mean percentile scores and standard deviations, the covariate adjusted mean percentile scores for each of the confounding factors, and the multivariate adjusted mean percentile scores when all factors are considered together. Where BMI was significantly associated with mean CTBS scores, statistics are provided. The ANCOVA analysis reveals that BMI was still associated with CTBS math percentile scores, even when controlling for SEL and behavior, but was not significant when controlling for each of the other variables. Additionally, all of the other confounding influences were found to significantly effect CTBS math percentile scores, by ANCOVA (all at $p \leq 0.01$). Finally, there were no significant difference in CTBS math percentile scores by BMI group in the MANCOVA including all confounding influences together. The factors that significantly affected CTBS math scores in the multivariate model of covariance were parents' level of education ($F=8.14$, $p \leq 0.01$) and teachers' prediction of school success ($F=59.00$, $p \leq 0.01$).

Table 9. Mean CTBS Math Percentile Scores, by BMI Group (unadjusted and adjusted)

BMI Group	Unadjusted[a] Mean ± S.D.	Adjusted Means: Absence	Parents' Level Ed.	SEL[b]	Pred. Success	Behavior[c]	Multivariate Model
1	67.47±27.90	67.61	68.87	67.33	66.24	67.10	68.13
2	66.10±28.35	65.86	66.31	65.51	65.78	67.09	65.87
3	67.52±27.94	67.43	66.60	68.07	67.72	67.51	67.20
4	69.53±27.39	69.54	70.66	69.58	69.63	69.68	70.48
5	62.20+29.16	62.51	65.80	62.48	64.93	61.89	68.33

[a] ANOVA : F=2.42, p≤0.05 Orthogonal Contrast BMI group 5 vs. 1, 2, 3, & 4, p ≤0.05
[b] ANCOVA: F=2.65, p≤0.03 Orthogonal Contrast BMI group 5 vs. 1, 2, 3, & 4, p≤0.02
[c] ANCOVA : F= 2.41, p≤0.05 Orthogonal Contrast BMI group 5 vs. 1, 2, 3, & 4, p≤0.05

Table 10 shows the statistics related to CTBS reading percentile scores. The covariate analysis reveals that BMI still has a significant effect on CTBS reading percentile scores, even when controlling for absences, parents' level of education and SEL. Orthogonal contrast showed that BMI group 5, the obese students, had lower mean scores. A weaker association existed between BMI and CTBS reading when controlling for behavior (p≤0.08). Additionally, all of the confounding influences were found to have a significant effect on CTBS reading percentile scores in the covariate model of analysis (p≤0.01). Finally, there were no significant differences in CTBS reading percentile scores by BMI group in a MANCOVA, controlling for all

confounding influences together. Those factors found to still have a significant influence on CTBS reading percentile scores were parents' level of education and teachers prediction of success ($p \leq 0.01$). Teachers' evaluation of student behavior and absences were found to have a weaker effect ($p \leq 0.09$).

Table 10. Mean CTBS Reading Percentile Scores, by BMI Group (unadjusted and adjusted)

		Adjusted Means					
BMI Group	Unadjusted[a] Mean ± S.D.	Absence[b]	Parents' Level Ed.[c]	SEL[d]	Pred. Success	Behavior	Multivariate Model
1	67.43±25.79	67.52	69.20	67.26	66.43	67.27	68.75
2	65.52±26.72	65.35	66.36	64.82	64.69	65.93	65.60
3	64.83+26.58	64.77	64.69	65.48	65.36	65.12	65.95
4	66.09±26.99	66.09	67.98	66.14	66.25	66.32	68.05
5	58.99±27.99	59.20	61.97	59.33	61.86	59.00	64.98

[a] ANOVA : F=3.12, p=0.01 Orthogonal Contrast BMI group 5 vs. 1, 2 ,3, & 4, $p \leq 0.05$
[b] ANCOVA: F=2.91, p=0.02 Orthogonal Contrast BMI group 5 vs. 1, 2, 3, & 4, $p \leq 0.01$
[c] ANCOVA: F=2.58, p=0.04 Orthogonal Contrast BMI group 5 vs. 1, 2, 3, & 4, $p \leq 0.03$
[d] ANCOVA: F=3.06, p=0.02 Orthogonal Contrast BMI group 5 vs. 1, 2, 3, & 4, $p \leq 0.01$

Table 11 shows the statistics related to CTBS total battery percentile scores. ANOVA of total battery scores by BMI groups showed significant differences. Orthogonal contrast revealed that BMI group 5, the obese

students, scored lower. The covariate analysis reveals that BMI is still significantly associated with CTBS total battery percentile scores, even when controlling for SEL and behavior, but not when controlling for the other factors. The confounding factors that were found to be significantly associated with CTBS total battery percentile scores by MANCOVA, (all at $p \leq 0.02$) were parents' level of education, teachers' predicted school success, and teachers' perception of student behavior. There were no significant differences in CTBS total battery percentile scores by BMI group, by MANCOVA.

Table 11. Mean CTBS Total Battery Percentile Scores, by BMI Group (unadjusted and adjusted)

		Adjusted Means					
BMI Group	**Unadjusted[a] Mean±S.D.**	**Absence**	**Parents' Level Ed.**	**SEL[b]**	**Pred. Success**	**Behavior[c]**	**Multivariate Analysis**
1	70.14±25.86	70.27	71.69	69.96	68.93	69.84	71.07
2	68.59±27.45	68.35	69.11	67.84	67.61	69.05	68.16
3	69.66±26.57	69.58	69.08	70.36	69..86	69.58	69.92
4	70.24±26.68	70.24	72.04	70.30	70.31	70.41	71.80
5	62.93±27.84	63.23	66.09	63.29	65.85	62.44	68.90

[a] ANOVA: F=2.73, p=0.03 Orthogonal Contrast BMI group 5 vs. 1, 2 ,3, & 4, $p \leq 0.01$
[b] ANCOVA: F=3.00, p=0.02 Orthogonal Contrast BMI group 5 vs. 1, 2, 3 & 4, $p \leq 0.01$
[c] ANCOVA: F=2.34, p=0.05 Orthogonal Contrast BMI group 5 vs. 1 ,2, 3, & 4, $p \leq 0.01$

Hypothesis 3

There were significant differences in teachers' predicted school success for third-grade white females participating in the OMNIBUS project, by BMI group ($F = 2.80$, $p \leq 0.03$). Orthogonal contrast of BMI group 5 vs. BMI groups 1, 2, 3, & 4 revealed a significant difference ($p \leq 0.01$). Therefore, the null hypothesis was rejected. Table 12 shows the mean teachers' predicted success by BMI group. This suggests that the heaviest girls were predicted to have significantly less school success.

Table 12. Mean Teachers' Predicted School Success by BMI Group

BMI Group	Mean Teachers' Predicted Success[a]	Std. Error
1	1.68	0.04
2	1.68	0.05
3	1.76	0.05
4	1.74	0.04
5	1.91	0.06

[a]Catagories of Predicted Success: 1=Strongly Agree, 2=Agree, 3=Undecided, 4=Disagree

ANOVA: $F=2.80$, $p \leq 0.03$
Orthogonal Contrast of BMI Group 5 vs. 1, 2, 3, & 4: $p \leq 0.01$

Hypothesis 4

Teachers' prediction of school success in second-grade was related to actual third-grade performance. The null hypothesis was rejected.

Table 13 shows the statistics related to CTBS math percentile scores. This includes, by category of teachers' predicted school success, the unadjusted mean percentile scores and standard deviations, the covariate adjusted mean percentile scores, and the multivariate adjusted mean percentile scores when all factors are considered together. Mean CTBS math scores, by category of teachers' predicted success were found to be significantly different ($p \leq 0.04$). ANCOVA of teachers' predicted school success was performed with each of the confounding factors, to test the effect on the outcome variable (e.g., CTBS percentile scores). ANCOVA revealed that teachers' prediction of school success had a significant effect on CTBS percentile math scores even when controlling for each of the other factors. Finally, MANCOVA of teachers' predicted school success and all confounding factors together was performed. The multivariate model revealed that teachers'prediction of school success remained a highly significant factor in determining CTBS math percentile scores. Parents' level

of education also had a significant effect on CTBS math percentile scores ($p \leq .0.01$).

Table 13. Mean CTBS Math Percentile Scores, by Category of Teachers' Predicted School Success (unadjusted and adjusted)

		Adjusted Means					
Teachers Predicted Success	Unadjusted[a] Mean ±S.D	BMI[b]	Abs[c]	Parents' Level Ed.[d]	SEL[e]	Behavior[f]	Multivariate Model[g]
Strongly Agree	79.97±21.13	80.02	79.79	78.41	79.59	80.40	78.26
Agree	62.82±27.31	62.77	62.82	64.34	63.00	62.93	64.53
Undecided	44.17±26.70	44.13	44.54	47.11	44.84	43.23	47.36
Disagree	33.10±27.24	32.94	34.00	35.69	33.78	31.93	36.00

[a]ANOVA, F= 2.60, $p \leq 0.04$
[b]ANCOVA, F=163.01, $p \leq 0.01$
[c]ANCOVA, F=153.44, $p \leq 0.01$
[d]ANCOVA, F= 98.44, $p \leq 0.01$
[e]ANCOVA, F=147.02, $p \leq 0.01$
[f]ANCOVA, F=109.41, $p \leq 0.01$
[g]MANCOVA, F= 59.00, $p \leq 0.01$

Table 14 shows the statistics related to CTBS reading percentile scores. This includes, by category of teacher's predicted school success, the unadjusted mean percentile scores and standard deviations, the covariate adjusted mean percentile scores, and the multivariate adjusted mean percentile scores when all factors are considered together. Mean CTBS

reading scores, by category of teachers' predicted success were found to be significantly different ($p \leq 0.01$). ANCOVA of teachers' predicted school success was performed with each of the confounding factors, to test the effect on CTBS math scores. This analysis revealed that teachers' prediction of school success had a significant effect on CTBS reading percentile scores even when controlling for each of the other factors. Finally, MANCOVA of teachers' predicted school success and all of the confounding factors together was performed. This analysis revealed that teachers' prediction of school success remained a highly significant factor in determining CTBS reading percentile scores. Also found to be significant in the multivariate model was parents' level of education ($p \leq 0.01$).

Table 14. Mean CTBS Reading Percentile Scores, by Category of Teachers' Predicted Success (unadjusted and adjusted)

		Adjusted Means					
Teachers' Predicted Success	Unadjusted[a] Mean ±S.D.	BMI[b]	Abs[c]	Parents' Level Ed.[d]	SEL[e]	Behavior[f]	Multivariate Model[g]
Strongly Agree	77.46±20.85	77.41	77.39	76.81	76.83	77.83	76.80
Agree	61.23±25.12	61.26	61.23	63.55	61.53	61.40	63.87
Undecided	43.31±26.30	43.34	43.44	45.23	44.44	42.40	44.98
Disagree	30.68±27.17	30.81	31.00	36.03	31.82	29.57	35.59

[a]ANOVA: F= 3.12, p≤0.01
[b]ANCOVA: F=164.69, p≤0.01
[c]ANCOVA: F=158.27, p≤0.01
[d]ANCOVA: F=102.31, p≤0.01
[e]ANCOVA: F=145.57, p≤0.01
[f]ANCOVA: F=113.14, p≤0.01
[g]MANCOVA: F= 63.69, p≤0.01

Table 15 shows the statistics related to CTBS total battery percentile scores. This includes, by category of teachers' predicted school success, the unadjusted mean percentile scores and standard deviations, the covariate adjusted mean percentile scores, and the multivariate adjusted mean percentile scores when all factors are considered together. Mean CTBS total battery scores, by category of teachers' predicted success were found to be significantly different ($p \leq 0.03$). ANCOVA of teachers' predicted school success was performed with each of the confounding influences to test the

effect on CTBS total battery percentile scores. This analysis revealed that teachers' prediction of school success was significantly associated with CTBS total battery percentile scores even when controlling for each of the other factors. Finally, MANCOVA of teachers' predicted school success and all of the confounding factors together was performed. The multivariate model revealed that teachers' prediction of school success remained a highly significant factor in determining CTBS total battery percentile scores. Parents' level of education and teachers' evaluation of student behavior were also found to have a significant association with CTBS total battery percentiles ($p \leq 0.01$ and $p \leq 0.02$, respectively).

Table 15. Mean CTBS Total Battery Percentile Scores, by Teachers' Category of Predicted Success (unadjusted and adjusted)

Teachers' Predicted Success	Unadjusted[a] Mean±S.D.	Adjusted Means: BMI[b]	Abs[c]	Parents' Level Ed.[d]	SEL[e]	Behavior[f]	Multivariate Model[g]
Strongly Agree	83.00±18.51	83.00	82.85	81.62	82.39	83.18	81.37
Agree	63.96±24.71	63.96	63.96	66.05	64.25	64.19	66.38
Undecided	43.29±25.34	43.29	43.61	45.68	44.40	42.75	46.05
Disagree	30.19±26.56	30.29	31.05	35.24	31.39	29.66	35.57

[a]ANOVA: F= 2.73, p≤0.03
[b]ANCOVA: F=245.93, p≤0.01
[c]ANCOVA: F=233.59, p≤0.01
[d]ANCOVA: F=154.43, p≤0.01
[e]ANCOVA: F=219.02, p≤0.01
[f]ANCOVA: F=161.21, p≤0.01
[g]MANCOVA: F= 92.29, p≤0.01

Hypothesis 5

There are no differences in teachers' perception of student behavior between groups of "normal weight" students and a group of obese students, participating in the OMNIBUS project. The null hypothesis was not rejected. There were no significant differences in teachers' perception of student behavior by BMI group, and there were no trends or patterns in teachers'

responses, by BMI groups.

Tables 16, 17, and 18 show data related to CTBS math, CTBS reading, and CTBS total battery percentile scores, respectively. They include, by category of teachers evaluation of student behavior, the unadjusted mean percentile scores and standard deviations, the covariate adjusted mean percentile scores, and the multivariate adjusted mean percentile scores when all factors are considered together.

Teachers' evaluation of student behavior was a significant factor in determining mean CTBS scores in the one-way ANOVA and ANCOVA. Additionally, ANCOVA showed that BMI was a significant factor effecting CTBS math and total battery percentile scores ($p \leq 0.05$), but was not significant for CTBS reading percentile scores ($p \leq 0.08$). BMI was not a significant factor effecting CTBS reading percentile scores when tested by MANCOVA. Likewise, MANCOVA revealed teachers' evaluation of student behavior only had a significant effect on CTBS total battery percentile scores ($p \leq 0.02$), but not on CTBS math or reading percentile scores. Finally, MANCOVA showed parents' level of education and teachers' prediction for school success significantly affected all CTBS percentile scores (e.g. math, reading, and total battery) at $p \leq 0.01$.

Table 16. Mean CTBS Math Percentile Scores, by Teachers' Evaluation Of Student Behavior (unadjusted and adjusted)

		Adjusted Mean					
Teachers' Evaluation of Student Behavior	**Unadjusted[a] Mean±S.D.**	**BMI[b]**	**Pred. Success[c]**	**Abs[d]**	**Parents' Level Ed.[e]**	**SEL[f]**	**Multivariate Model**
Excellent	74.40±25.28	74.43	67.75	74.38	73.72	73.94	68.80
Satisfactory	58.83±29.18	58.79	65.68	58.85	61.82	59.44	67.15
Needs Improvement	51.12±29.10	51.05	70.79	51.06	52.06	51.88	68.29
Unsatisfactory	62.93±21.38	62.80	88.15	63.49	66.27	63.72	84.61

[a]ANOVA: F=49.74, p≤0.01
[b]ANCOVA: F=49.69, p≤0.01
[c]ANCOVA: F= 5.09, p≤0.01
[d]ANCOVA: F=50.42, p≤0.01
[e]ANCOVA: F=29.08, p≤0.01
[f]ANCOVA: F=42,89, p≤0.01

Table 17. Mean CTBS Reading Percentile Scores, by Teachers' Evaluation of Student Behavior (unadjusted and adjusted)

		Adjusted Means					
Teachers' Evaluation of Student Behavior	**Unadjusted[a] Mean±S.D.**	**BMI[b]**	**Pred. Success[c]**	**Abs[d]**	**Parents' Level Ed.[e]**	**SEL[f]**	**Multivariate Model**
Excellent	72.14±23.98	72.08	65.68	72.13	72.38	71.54	67.34
Satisfactory	57.22±28.05	57.29	63.89	57.24	60.40	58.02	65.92
Needs Improvement	50.82±28.21	50.94	69.93	50.78	52.56	51.81	69.02
Unsatisfactory	55.80±29.51	56.03	80.31	56.16	61.57	56.84	83.01

[a]ANOVA: F=48.82, p≤0.01
[b]ANCOVA: F=47.49, p≤0.01
[c]ANCOVA: F= 4.35, p≤0.01
[d]ANCOVA: F=46.94, p≤0.01
[e]ANCOVA: F=29.64, p≤0.01
[f]ANCOVA: F=40.43, p≤0.01

Table 18. Mean CTBS Total Battery Percentile Scores, by Teachers' Evaluation of Student Behavior (unadjusted & adjusted)

		Adjusted Means					
Teachers' Evaluation of Student Behavior	**Unadjusted[a] Mean±S.D.**	**BMI[b]**	**Pred.[c] Success**	**Abs[d]**	**Parents' Level Ed.[e]**	**SEL[f]**	**Multivariate Model[g]**
Excellent	76.97±23.03	76.95	69.69	76.95	76.50	76.35	70.94
Satisfactory	59.35±28.24	59.37	66.85	59.38	62.83	60.18	68.88
Needs Improvement	50.93±28.13	50.96	72.50	50.87	52.17	51.95	70.41
Unsatisfactory	58.47±25.01	58.53	86.12	59.00	65.66	59.54	89.51

[a]ANOVA: F=72.15, p≤0.01
[b]ANCOVA: F=71.16, p≤0.01
[c]ANCOVA: F= 5.90, p≤0.01
[d]ANCOVA: F=71.28, p≤0.01
[e]ANCOVA: F=44.25, p≤0.01
[f]ANCOVA: F=61.60, p≤0.01
[g]MANCOVA: F= 3.44, p≤0.02

CHAPTER 5. DISCUSSION AND CONCLUSIONS

Little is known from published research about the relationship between academic achievement and obesity in children. The present study is unique in that it addresses a topic for which there is a paucity of research and, and involves a large number of subjects. This research extends present knowledge related to this subject and provides useful information for future research.

Analysis of the data indicates that while BMI is not associated with classroom grades, it is significantly, negatively associated with CTBS scores, by one-way ANOVA. However, when controlling for the confounding influences of teachers' predicted school success, parents' level of education, SEL, absences, and behavior, MANCOVA shows BMI was not significantly associated with academic achievement on the CTBS. With respect to the secondary issues of this investigation, teachers' prediction of school success is found to be highly, negatively associated with BMI. That is, teachers predict the highest degree of success for the students with the lowest mean BMI and conversely, the lowest degree of success for those students with the highest mean BMI. Further, teachers' prediction for school success in second

grade is significantly associated with student performance on a standardized test in third-grade. Finally, there were no significant differences in teacher evaluation of student behavior by BMI group.

The following sections of this chapter provide a more detailed discussion of the hypothesis testing, and conclusions are drawn based upon the results. The chapter ends with final conclusions and recommendations for future research.

Hypothesis 1

The present study provides little evidence to support a hypothesis that obesity negatively affects classroom grades in the subjects of math, reading, and science. While the correlation matrix shows a significant negative correlation between BMI and classroom grades ($p \leq 0.05$, $p \leq 0.01$, and $p \leq 0.07$, respectively), one-way ANOVA of BMI between groups showed no significant differences in classroom grades.

As Table 7 illustrates, the students in all 5 BMI groups had a grade-point average of "B" in all three subject areas. Since "B" is considered "above average," it calls into question why the average grade for 1,667

students is so high. Possibly classroom grades are not entirely an objective measure of achievement. Classroom grades for these subjects might have been influenced by the following factors: 1) all subjects were white, 2) they missed few days of school (average of approximately 8 days, per entire school year, 3) more than half of the subjects' parents had completed at least one year of college, and, 4) 72% of the subjects were from families with incomes $\geq$ 185% of the poverty line. Further, there may be a tendency toward grade inflation with respect to classroom grades.

Alternatively, these findings may reflect that there is no relationship between childhood obesity and academic achievement. Also, it is possible that students react differently to their obesity. Obese youngsters may have a tendency to overcompensate academically for deficiencies in social and athletic competencies. Finally, a factor possibly affecting the outcome of the present study is that third-grade children have not yet internalized a negative self-image, or developed negative self-esteem with respect to their physical size, which is often the case in preadolescent children and adolescents. Sheila Hill Turrentine (1981) found preadolescent (6th-graders) and adolescent (9th graders) obesity correlated strongly with poor self-concept and low academic achievement.

Hypothesis 2

Data from this research provides weak evidence to support the hypothesis for an association between BMI and academic achievement. The correlation matrix indicates significant correlations between BMI and CTBS Math, Reading and Total Battery percentile scores. However, the correlations are rather weak, with r-values of -0.03, -0.07, and -0.06, respectively. One-way ANOVA of CTBS percentile scores and BMI indicates a significant difference. Table 8 reveals that BMI group 5, the obese students, have significantly lower mean CTBS Math, Reading and Total Battery percentile scores.

When controlling for each of the confounding factors, in an ANCOVA, the association between BMI and mean percentile scores are somewhat weaker. For example, significant association between BMI and CTBS Math percentile scores continues to exist when controlling for SEL and teachers' perception of student behavior, but not when controlling for the other factors. Likewise, BMI was not significantly associated with outcomes in a MANCOVA. The two factors with the most significant relationship to CTBS Math percentile scores were parents' level of education and teachers'

prediction of success ($p \leq 0.01$).

BMI continues to have a significant association with CTBS Reading percentile scores, even when controlling for absences, parents' level of education and SEL in an ANCOVA ($p \leq 0.05$). However, it is not significantly associated with the outcome variable in a MANCOVA.

BMI continues to have a significant relationship to CTBS Total Battery percentile scores, even when controlling for SEL and teachers' evaluation of student behavior in an ANCOVA ($p \leq 0.05$). However, as with the other CTBS outcomes, BMI is not significantly associated with Total Battery scores in a MANCOVA.

These results are consistent with John G. Freeman's (1990) findings where he found no significant relationship between ponderal index and a standardized reading test, by multiple regression. Freeman did find, however, that by subjectively measured obesity (self-evaluation), sixth grade girls had lower academic achievement.

The correlation matrix reveals a weak, but significant negative association between BMI and parents' level of education, $r = -0.07$, $p \leq 0.01$. In other words, as parents' level of education decreases, BMI increases. Further, there was a moderately high, significant correlation between parents'

level of education and CTBS Math, Reading and Total Battery percentile scores (all: $r \geq 0.28$ and $p \leq 0.01$). In MANCOVA's of CTBS Math, Reading, and Total Battery, the only factors that are significantly related to outcomes are parents' level of education, and teachers' prediction for school success, at $p \leq 0.01$ for all CTBS outcomes. It would seem that the effect of these two variables on CTBS outcomes is so significant, that they minimize the weaker effect of BMI, to the extent that BMI is no longer significant when considered with all of the controlling factors together, in a MANCOVA. Therefore, while BMI is weakly associated with CTBS percentile scores, parents' level of education, and teachers' prediction for school success have the strongest association with CTBS percentile scores of all factors examined.

Hypothesis 3

The data serves to reject the null hypothesis and support the idea that obesity is negatively associated with teachers' prediction of school success. ANOVA reveals significant differences in teachers' prediction of school success by BMI groups. Orthogonal contrast (BMI group 1 vs. groups 2, 3,

4, & 5) demonstrates that teachers do predict the highest degree of school success for the thinnest girls (see Table 5).

This investigation supports the notion that teachers base their predictions for academic success on the basis of student attributes unrelated to academic achievement. Likewise, Schroer (1985) demonstrated similar findings when he found teachers based their expectations for achievement on student obesity. In his study, teachers viewed obese children as less hardworking, less energetic, and less attractive than other students. Clifford & Walster (1973) found that unattractive students were expected to have lower I.Q. scores and less academic potential. Tershakovec, et. al. (1993) observed that obese, Black students were placed into remedial educational settings more often than their thinner counterparts, indicating they were perceived differently by their teachers.

Teachers' prediction of school success is one of two factors highly associated with CTBS percentile scores, and BMI appears to strongly influence those predictions. Teachers' expectancies are transmitted to their students, and the message is that teachers expect the highest level of academic achievement from the thinnest students, and a lower level of achievement from the obese students. Teacher expectations have a powerful

effect on student behavior, becoming a self-fulfilling prophecy for the students (Brophy and Evertson, 1981). Though BMI by itself appears to be weakly associated with academic achievement, it is through the mediating effect of BMI on teacher expectations that BMI influences academic achievement. Differences in teachers' expectations for academic success for certain students leads to differential treatment of those students in the classroom. This differential treatment may range from subtle differences in teacher behavior toward obese students, to placing those students in remedial classrooms. The conclusions are that teachers expect less academic success from obese students, and those students do have lower mean percentile scores in math, reading, and total battery, on standardized tests.

The other factor highly associated with academic achievement is parents' level of education. Parents who are highly educated expect higher levels of academic achievement from their children than less educated parents. The average level of parent education in this investigation is one year of college. Since this represents a higher level of parent education than the national average, higher parent expectations may have a moderating effect on teachers' expectations, with respect to the obese students. This further explains why the association between BMI and academic achievement was

diminished in the MANCOVA.

Hypothesis 4

Hypothesis testing supports the idea that teachers' are very accurate predictors of future school success for their students. For CTBS Math, Reading, and Total Battery, in the teachers' category of 'Strongly Agree', the students achieved mean scores between the 77th and 83rd percentiles. In the teachers' category "Agree', students achieved mean scores between the 61st and the 63rd percentiles. For the teachers'category 'Undecided', students achieved a mean score between the 43rd and 44th percentiles. Finally, for the teachers' category 'Disagree', students achieved mean scores between the 30th and 33rd percentiles.

In addition to the conclusions that teachers predict the highest level of school success for the thinnest girls, and teachers' predictions for school success are significantly associated with standardized test scores, it is also concluded that teachers accurately predict the future school success of their students. All of this information indicates that teachers' predictions, or stated another way, their expectations for student success, has a powerful

association with student achievement

.

Hypothesis 5

The data shows no significant association between obesity and student behavior, and therefore the null hypothesis is not rejected. This is contrary to the results of Terschakovec, et. al. (1993) who found that while 104 inner-city black third- and fourth-grade boys and girls scored within the normal range, they had higher scores on behavior tests, suggesting they may have more behavior problems. The difference in results between the present investigation and Terschakovec's findings may be related to several factors. Terschakovec's subjects were Black, inner-city boys and girls, while the subjects of the present study were white girls, predominately from families with incomes $\geq$ 185% of the poverty line. It may be that by controlling for sex and race in this study, student behavior was controlled for as well. Also, the present study involved a much larger sample population. Lastly, it is possible that the instrument Terschakovec used to evaluate student behavior (Child Behavior Checklists), along with his protocol (a lengthy telephone interview with each subject's primary care taker), provided a more sensitive

measure of student behavior than the single question answered by students' teachers in the present study. The results of the present investigation are also contrary to the findings of Strauss, et. al. (1985) in which teachers of second- through fifth-grade students were rated by their teachers to have more conduct problems.

It is interesting to note from Tables 16, 17 and 18 that teachers' evaluation of student behavior is not well correlated with CTBS scores. More specifically, if one examines the mean CTBS percentile scores for Math, Reading and, Total Battery, by category of teachers' evaluation of student behavior, mean percentile scores do not necessarily decrease as teacher evaluation of behavior decreases. For example, for teachers' category 'needs improvement', the mean scores are between the 50th and 51st percentile. However, for the teachers' category 'Unsatisfactory', the mean scores are between the 55th and 62nd percentiles. It is concluded that obese students do not have significantly different behavior than "normal-weight" students, and that student behavior is not necessarily associated with achievement on standardized tests.

Conclusions and Recommendations

This study was undertaken to determine if a relationship exists between academic achievement and BMI in third-grade white females. Firstly, it was hypothesized that there are no differences in classroom grades between groups of "normal-weight" students and a group of obese students. There was no evidence that objectively measured obesity negatively affects classroom grades.

Secondly, it was hypothesized that there are no differences in standardized test scores between groups of "normal-weight" students and a group of obese students. A weak, but significant association exists, as demonstrated by Pearsons correlation matrix, between BMI and academic achievement on the math, reading and total battery sections of the CTBS. Further, obese students have lower mean CTBS Math, Reading, and Total Battery percentile scores, as compared to "normal-weight" students, and that difference is significant by one-way ANOVA, all at $p \leq 0.05$. The effect of BMI on academic achievement becomes weaker when controlling for confounding influences. In a MANCOVA, BMI level did not explain academic achievement, however teachers' prediction of school success and

parents' level of education remain highly significant, both at $p \leq 0.01$.

Thirdly, it is hypothesized that there are no differences in teachers' predicted school success for third-grade white females between groups of "normal-weight" students and a group of obese students. The evidence shows that as teachers' prediction for school success decreases, BMI increases. Further, the girls with the lowest mean BMI are predicted to have the highest level of academic success.

Fourthly, it is hypothesized that second-grade teachers' predictions for academic success are not related to actual third-grade performance. The data shows that teachers are excellent predictors of future academic success, reflected by the mean CTBS scores for each category of teachers' prediction. For example, for the teachers' category 'Strongly Agreed', students scored less than or equal to the 77th percentile in the three areas of the CTBS. For the teachers' category 'Disagree', students scored less than or equal to the 33rd percentile in the three areas of the CTBS.

Lastly, it is hypothesized that there was no differences in teachers' perception of student behavior between groups of "normal-weight" students and a group of obese students. The data does not provide evidence to reject the null hypothesis. There was no significant difference in teachers'

perception of student behavior by BMI. In a MANCOVA of student behavior and all confounding factors, student behavior is significantly related to CTBS Total Battery percentile scores, but not to CTBS Math or Reading percentile scores. As seen previously, teachers' prediction for school success and parents' level of education are significantly related to performance on CTBS, by MANCOVA. It is likely that the present study controlled for student behavior to some degree by only including white females in the study population.

A model is presented, linking BMI with academic achievement in schoolchildren, through the mediating factors of teachers' predictions for success (teacher expectancies), and parents' level of education. BMI negatively influences teachers' scholastic expectations for their students, which then becomes a self-fulfilling prophecy. In this model, obesity might be viewed as an educational handicap. In this study, the effects of teachers' expectancies are moderated by the higher average level of parent education, and therefore, higher parent expectancies.

Future avenues of inquiry might include a similar study with an ethnically diverse population, including both sexes, from a more economically diverse school district. Considering the OMNIBUS project follows a cohort

of students for 13 years, a longitudinal investigation would provide important information about 1) trends in childhood obesity, 2) trends in academic achievement as the youngsters become adolescents, 3) whether teachers' continue to accurately predict academic achievement for their students, and 4) whether behavior issues become a problem for obese youngsters as they enter adolescence. The results of future investigations could be used to help identify "at risk" schoolchildren and create interventions to increase academic achievement.

APPENDIX A
ANTHROPOMETRIC CONSENT LETTER

PINELLAS COUNTY SCHOOLS

Department of Educational Accountability

MEMO

October 5, 1992

On Wednesday, October 21st all third grade students in Bauder Elementary School will be weighed and measured as part of this years Omnibus Project data collection activities. The weights and measures will be done in school by personnal from the College of Public Health at the University of South Florida. If you do not wish you child to participate, please notify the school in writing on/or before Wednesday, October 21st.

APPENDIX B
ANTHROPOMETRIC DATA SHEET

ANTHROPOMETRIC MEASUREMENTS
PINELLAS COUNTY OMNIBUS STUDY

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Student Number

Student Name

Grade

School Number

School Name

Date

FOR OFFICE USE ONLY - PLEASE MAKE NO MARKS IN THIS AREA

DATE

Month

○ Jan ○ Jul
○ Feb ○ Aug
○ Mar ○ Sep
○ Apr ○ Oct
○ May ○ Nov
○ Jun ○ Dec

Day

00 11 22 33 4 5 6 7 8 9

Year

○ 92
○ 93
○ 94
○ 95
○ 96
○ 97
○ 98
○ 99

MEASURER

BASIC MEASUREMENTS

Height (inches)

1st | 2nd

average /8

Weight (pounds)

1st | 2nd

average .

Circumferences

Waist (inches)

1st | 2nd

average /8

Hip (inches)

1st | 2nd

average /8

SIDE 1

APPENDIX C
TEACHERS' SURVEY - SECOND GRADE

TEACHER SURVEY FILE
Second Grade 1991-92

DIFFICULTY PAYING ATTENTION

SPSS Name: Q01T91
SPSS Type: 1-Character Numeric
Element Number: 900622
Definition: Question 1: "Does this student have difficulty paying attention?"

1 Yes
2 No
3 Undecided

MET WITH PARENTS ON PROGRESS

SPSS Name: Q02T91
SPSS Type: 1-Character Numeric
Element Number: 900623
Definition: Question 2: "Have the parents of this student met with you to discuss the student's progress?."

1 Yes
2 No

RECEIVED VOLUNTEER SERVICES

SPSS Name: Q03T91
SPSS Type: 1-Character Numeric
Element Number: 900624
Definition: Question 3: "Did this student receive services from an instructional volunteer during at least one grading period?"

1 Yes
2 No

ATTITUDE TOWARD SCHOOL

SPSS Name: Q04T91
SPSS Type: 1-Character Numeric
Element Number: 900625
Definition: Question 4 "How would you describe this student's attitude toward school?"

1 Very positive
2 Positive
3 Neutral
4 Negative
5 Very Negative

TEACHER PREDICTED SCHOOL SUCCESS

SPSS Name: Q05T91
SPSS Type: 1-Character Numeric
Element Number: 900622
Definition: Question 5: "To what extent do you agree with the statement, "This student will have a successful overall school experience"?

1 Strongly Agree
2 Agree
3 Undecided
4 Disagree
5 Strongly disagree

TEACHER PERCEPTION OF BEHAVIOR

SPSS Name: Q06CT91
SPSS Type: 1-Character Numeric
Element Number: 900627
Definition: Question 6 "Choose the answer that best describes this student's behavior in the school."

1 Excellent
2 Satisfactory
3 Needs improvement
4 Unsatisfactory

RACIAL/ETHNIC CATEGORY

SPSS Name: RACE
SPSS Type: 1-Character Alphanumeric
Element Number: 168025
Definition: The racial/ethnic group to which the student belongs or with which the student identifies."

A Asian or Pacific Islander
B Black, Non-Hispanic
H Hispanic
I American Indian or Alaska Native
W White, Non-Hispanic

LOCATION OF STUDENT

SPSS Name: LOCATE
SPSS Type: 1-Character Numeric
Element Number: 900630
Definition: A one-character code that indicates whether the student was in Pinellas County schools

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